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NOTE OF INTEREST: Lunar Surface Contingency Lift-off Procedures

1. For the previous Apollo missions, a procedure for "no PGNS auto ignition" for lunar lift-off has existed, which was designed to meet the following two constraints:

a. To provide for redundant APS-ON signals if possible.

b. To lift-off within 10 seconds of nominal Tig in order to achieve a direct rendezvous.

After the Apollo 16 LM jettison attitude control problem, another constraint evolved which is inconsistent with current procedures. This new constraint, that of checking the attitude control circuitry via a hot-fire after an attitude control configuration change, has caused Apollo 17 checklists to be modified to perform the PGNS portion of the lunar surface hot-fire test last. Another constraint change which impacts the existing procedure is that the 10-second limitation for the direct rendezvous has been relaxed to 30 seconds. This allows more time to execute an alternate procedure as will be examined below.

2. Several options are available which could change the existing procedure to ensure attitude control at lift-off. In some cases, however, this is at the expense of the other constraints. These options and the advantages and disadvantages are as follows:

a. "Safe" the vehicle and wait one rev.

Although this action has the advantage of not hurrying, troubleshooting, and lifting off in the best possible configuration, it causes a powerdown and reconfiguration problem. Also, waiting another two hours on the surface subjects the vehicle to additional failure risks.

b. Immediate manual ignition via START p.b.

An immediate manual start in PGNS does prevent the risk of lifting off in AGS with possibly no attitude control, and obviously can be accomplished in time to make a direct rendezvous. However, the constraint of providing for a redundant APS-ON signal, if possible, would be ignored, and is the main objection to this procedure.

c. Modify original procedure to include Hot-Fire checks after Switching between PGNS and AGS.

Since the original procedure conforms to all constraints except verifying AGS attitude control prior to an AGS auto ignition, it can be modified to include a quick hot-fire check via the ACA prior to ignition. Switching to AGS in the lift-off configuration should cause an auto-on command to be issued and therefore, the AGS would need to be "safed" prior to switching to AGS. This can be accomplished by

already having the AGS MODE CONT switch in ATT HOLD or switching to ATT HOLD, or resetting the ABORT STAGE p.b. prior to selecting AGS. After the crew's assessment of a quick hot-fire check, auto ignition could be allowed via the opposite "safing" action, i.e., switching to AUTO or pushing the ABORT STAGE p.b. This procedure should be able to be performed within the new 30-second time constraint for the direct rendezvous. Although both methods of safing the AGS for the hot-fire check would be acceptable, resetting the ABORT STAGE seems to adhere best to the constraints. Performing the hot-fire in the AGS ATT HOLD does have a slight disadvantage of changing the attitude control configuration after the test by switching to AUTO. This switching causes enable power to the abort preamps to be switched between two contacts of the AGS MODE CONT switch. However, resetting the ABORT STAGE p.b. allows the attitude control circuitry which will be used for the ascent to be checked end-to-end. Both methods require action to safe the AGS prior to its selection unless the AGS MODE CONT switch was placed in ATT HOLD prior to the final countdown. However, this would cause several checklist changes altering normal procedures for a possible contingency. Also, both methods are subject to a single point contact failure which would fail to remove the appropriate inbit to the AEA and cause ignition when AGS was selected.

3. As can be seen from analyzing the above options, arguments can be made for and against each. If the constraints of verifying attitude control and providing for redundant APS-ON are to be met, then safing the AGS for a hot-fire best meets these requirements. Resetting the ABORT STAGE p.b. is recommended over the AGS ATT HOLD method simply because it performs an end-to-end attitude control check and requires no attitude control configuration changes for ascent.

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